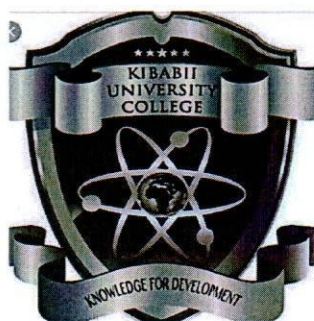


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KIBABII UNIVERSITY

UNIVERSITY EXAMINATIONS

2022/2023 ACADEMIC YEAR

SECOND YEAR FIRST SEMISTER EXAMINATION

FOR THE DEGREE

OF

BACHELOR OF SCIENCE (CHEMISTRY)

COURSE CODE: SCH 211./214*

COURSE TITLE: ATOMIC STRUCTURE AND CHEMICAL BONDING

INSTRUCTION: ANSWER ALL QUESTIONS

DATE: 20/12/2022

TIME: 2:00-4:00PM

This paper contains 4 printed pages

(MAIN EXAM)

Plank's constant, $h = 6.626 \times 10^{-34} \text{ Js}$

Speed of light(in vacuum), $c = 2.998 \times 10^8 \text{ ms}^{-1}$

Rydberg's constant, $R_H = 1.0968 \times 10^7 \text{ m}^{-1}$

Mass of electron, $m_e = 9.11 \times 10^{-31} \text{ kg}$

$1 \text{ \AA} = 10^{-10} \text{ m}$ and $1 \text{ J} = 1 \text{ kgm}^2\text{s}^{-2}$

Electronic charge, $e = 1.602 \times 10^{-19} \text{ C}$

Permittivity, $\epsilon_0 = 8.854188 \times 10^{-12} \text{ C}^2/\text{Jm}$

QUESTION ONE (30MARKS)

a) Discuss the Rutherford atomic model (3mks)

b) Explain the Bohr's model of the atom citing its limitations (4mks)

c) Calculate the energy of an electron transition from $n=4$ in the Balmer series for the hydrogen atom predict its colour on spectrum line (2mks)

e) i) For a particle in a one dimension box, $E_n = \frac{n^2 h^2}{8ma^2}$, m =mass of particle

Calculate the energy difference between $n=2$ and $n=4$ levels for an electron confined to a one dimension box having length $1 \times 10^{-10} \text{ m}$ in joules (4mks)

ii) Given that $\Psi = A \sin\left(\frac{n\pi}{a}\right)x$. Sketch the plots for Ψ and Ψ^2 for $n=2$ for transitions in the box (4mks)

g) i) Briefly discuss malleability in copper metal (4mks)

ii) Why do metals shine when exposed to light (2mks)

h) State aufbau principles in filling electrons in multielectron atoms (3mks)

i) What is the difference between a covalent and dative bond. (2mks)

j) Briefly explain the relationship between screening effects and penetrating effects (2mks)

QUESTION TWO (20 MARKS)

a) Discuss the following terms

i) electronegativity and

ii) electron affinity (4mks)

- b) Explain why SiCl_4 has a lower melting point than SiO_2 (Si= 28, Cl=35.5, O=16) (4mks)
- c) Use CHCH to differentiate between pi (π) and sigma (δ) covalent bonds (4mks)
- d) Draw and identify intramolecular and intermolecular hydrogen bonds on nitrophenol molecule (4mks)
- e) Explain the trend in lattice energy down group 2 oxides (4mks)

QUESTION THREE (20 MARKS)

- a) Calculate the effective nuclear charge (Z_{eff}) for a 3d electron in iron (III) ion (Fe=26) (5mks)
- d) Account for the molecular shape of NH_3 using the VSEPR (4mks)
- e) Give 3 limitations of the valence bond theory (3mks)
- f) Describe the delocalization on benzene molecule, C_6H_6 (4mks)
- g) Draw the resonance structure for CO_3^{2-} (4mks)

QUESTION FOUR (20 MARKS)

- a) Explain why sodium chloride is not reactive whereas both its elements sodium and chlorine are very reactive (5mks)
- b) State 3 characteristics of an ionic compound (3mks)
- c) i) what is polarization (3mks)
- ii) Explain why KI(s) has a higher melting point than LiI (4mks)
- d) A radioactive material emits photons, each having energy of $1.6 \times 10^{-13}\text{J}$. Calculate the frequency and wavelength of the electromagnetic radiation emitted by the radioactive material (5 mks)

QUESTION 5 (20 MARKS)

- a) i) Use the allowed combination (n,l,m) to draw the orbitals in the outermost energy subshell in the table below. (5mks)

n	L	m	Orbital type
3	2	-2	
3	2	-1	
3	2	0	
3	2	1	
3	2	2	

- ii) Sketch the p-orbitals (3mks)
- b) State two limitations to the octet rule (3mks)
- c) Explain why the first ionization energy of B is 801KJ/mole while the one of Be is 899Kj/mole (4mks)
- d) Draw the homonuclear correlation diagram for boron and determine its magnetism (5mks)